

The IRMA code for unique classification of medical images

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ABSTRACT

Modern communication standards such as Digital Imaging and Communication in Medicine (DICOM) include non-image data for a standardized description of study, patient, or technical parameters. However, these tags are rather roughly structured, ambiguous, and often optional. In this paper, we present a mono-hierarchical multi-axial classification code for medical images and emphasize its advantages for content-based image retrieval in medical applications (IRMA). Our so called IRMA coding system consists of four axes with three to four positions, each in $\{0, \dots, 9, a, \dots, z\}$, where "0" denotes "unspecified" to determine the end of a path along an axis. In particular, the technical code (T) describes the imaging modality; the directional code (D) models body orientations; the anatomical code (A) refers to the body region examined; and the biological code (B) describes the biological system examined. Hence, the entire code results in a character string of not more than 13 characters (IRMA: TTTT – DDD – AAA – BBB). The code can be easily extended by introducing characters in certain code positions, e.g., if new modalities are introduced. In contrast to other approaches, mixtures of one- and two-literal code positions are avoided which simplifies automatic code processing. Furthermore, the IRMA code obviates ambiguities resulting from overlapping code elements within the same level. Although this code was originally designed to be used in the IRMA project, other use of it is welcome.

Keywords: Standardized Nomenclature, Digital Imaging and Communication in Medicine (DICOM), Picture Archiving and Communication Systems (PACS), Content-Based Image Retrieval (CBIR), Image Classification Code

1. INTRODUCTION

Modern communication standards include non-image data for a standardized description of study, patient, body region examined, and technical parameters related to the imaging modality in use. In order to provide comprehensive, detailed coverage for multi-specialty biomedical imaging, the College of American Pathologists (CAP), secretariat of the Systematized Nomenclature of Human and Veterinary Medicine (SNOMED), has entered into partnership with the Digital Imaging and Communications in Medicine (DICOM) Standards Committee and other professional organizations to develop a nomenclature that is needed for diagnostic imaging applications [1]. The SNOMED DICOM microglossary was developed to provide context-dependent value sets for DICOM coded-entry data elements, and semantic content specifications for reports and other structures composed of multiple data elements [2].

Although the capability of storing explicitly-labeled coded descriptors in DICOM images and reports improves the potential for selective retrieval of images and related information, the controlled terminology within the DICOM tables has been found to be insufficiently detailed for order entry systems [3] or even invalid, if values are set automatically by the system [4]. Concerning the needs for content-based image retrieval in medical applications (IRMA), a detailed coding scheme is required to describe (a) the imaging modality including technical parameters, (b) the orientation of the image with respect to the body, (c) the body region examined, and (d) the biological system investigated [5,6].

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In this paper, we present a mono-hierarchical (i.e., every son-node is connected to only one parent-node) multi-axial (i.e., more than one semantic axes) classification code for medical images [7] in English and emphasize its advantages for image retrieval in comparison to existing proposals supplementary to the DICOM standard.

2. METHODS

Within the IRMA system [5], categorization is the first of seven successive analyzing steps extracting content information from medical images. The categorization aims to establish intelligent processing strategies adapted to the current image under investigation. Therefore, valid relations between code and sub-code elements are "is-a" and "part-of" only. Consequently, the code must be strictly hierarchical in order to support semantic queries on a database. Furthermore, causality is important for grouping of processing strategies. Therefore, a mono-hierarchical scheme is required, where each sub-code element is connected to only one code element. Since categorization of medical images must cover all aspects influencing the image content and structure, a multi-axial scheme was designed. This scheme, which has been presented previously in German [7] is now available in English, as well.

3. RESULTS

The IRMA coding system consists of four axes with three to four positions, each in $\{0, \dots, 9, a, \dots, z\}$, where "0" denotes "unspecified" to determine the end of a path along an axis:

- T (technical): image modality
- D (directional): body orientation
- A (anatomical): body region examined
- B (biological): biological system examined

This allows a short and unambiguous notation (IRMA: TTTT – DDD – AAA – BBB), where T, D, A, and B denotes a coding or sub-coding digit of the technical, directional, anatomical, and biological axis, respectively. In addition, this notation avoids mixtures of one- and two-literal code positions.

3.1. Technical code for imaging modality

The T-code describes within a maximum of four positions the technical method. It starts with the physical source of image acquisition (e.g.: 1 "x-ray", 2 "ultrasound", 3 "magnetic resonance imaging", 4 "optical imaging", ...) showing more details in the modality position (e.g.: 11 "plain film projection radiography", 12 "fluoroscopy", 13 "angiography", 14 "computed tomography", ...). A third digit specifies the technique (e.g.: 111 "digital", 112 "analog", 113 "stereometry", 114 "stereography", ...), and the fourth position of the T-code assesses sub-techniques (e.g.: 1111 "tomography", 1112 "high energy", 1113 "low energy", 1114 "parallel beam", ...). A complete listing of the IRMA T-code is given in Appendix A. Note that the non-radiological part of this code (4 "nuclear medicine", 5 "optical imaging", 6 "biophysical procedures", 7 "others", 8 "secondary digitization") are not modeled completely.

3.2. Directional code for imaging orientation

This three-digit part of the IRMA-code incorporates a two-step orientation description starting with the common orientation (e.g.: 1 "coronal", 2 "sagittal", 3 "transversal", 4 "other") and giving a more detailed specification in the second position (e.g.: 11 "posteroanterior (PA)", 12 "anteroposterior (AP)"). Note that it is important to distinguish AP- and PA-directions since organs and bone structures might differ in scale, for instance, supposing plain x-ray chest imaging. Independent from the relative orientation of body region and imaging system, functional orientation tasks of the examination can also be described (e.g.: 111 "inspiration", 112 "expiration", 113, "Valsalva", 114 "phonation", ...). A complete listing of the IRMA D-code is given in Appendix B.

3.3. Anatomical code for body region examined

The IRMA-code supports complete coding of the anatomical region. In total, nine major regions are defined (e.g.: 1 "total body", 2 "head/skull", 3 "spine", 4 "upper extremity", ...). The major region is followed by up to two

hierarchical sub-codes (e.g.: 3 "spine", 31 "cervical spine", 311 "dens"). A complete listing of the IRMA A-code is given in Appendix C.

3.4. Biological code for biological system examined

The B-code determines the organ system that is imaged. This axis is necessary because the body region examined insufficiently describes content and structure of images. For example, fluoroscopy of the abdominal region may access the vascular or the gastrointestinal system depending on the way the contrast agent is administered, which results in different image textures. On the top-level of this three digit IRMA-code, ten organ systems are specified (e.g.: 1 "cerebrospinal system", 2 "cardiovascular system", 3 "respiratory system", 4 "gastrointestinal system", ...) each of which having up to three positions to exactly identify the organ in question (e.g.: 1 "cerebrospinal system", 11 "central nervous system", 111 "mesencephalon"). A complete listing of the IRMA B-code is given in Appendix D.

3.5. Examples of image coding

A web-based interface has been established for coding of radiographs [8]. All images are converted to readable icons of about 200 x 200 pixels and labeled with the appropriate code by two professional readers, i.e. board certified radiologists. This allowed the assessment of the quality of computerized image categorization and also to create a gold standard. The labeling tool is based on an relational database addressed with standard query language (postgresql 7.1.3), an interface to a web-server (apache 1.3.26 with built-in php 4.2.2 interpreter) and on the client-site on a standard internet browser (mozilla 1.1). The appropriate code is entered and remarks of the readers are collected. The code can be entered directly into the appropriate field, if known by heart, or composed – making extensive use of javascripting in the HTML-file to enable modifying pop-up menus according to the decision made at higher levels. This resulted in a stepwise refinement of the code. The radiological report is available simultaneously to judge for specific comments. Thereafter, coded images are transferred anonymously from the routine application into the IRMA research case database [8].

Figure 1 gives two examples of unambiguous image classification using the IRMA-code. The image on the left is coded: "x-ray, projection radiography, analog, high energy – sagittal, left lateral decubitus, inspiration – chest, lung – respiratory system, lung. The image on the right is coded: x-ray, fluoroscopy, analog – coronad, ap, supine – abdomen, upper abdomen, middle – gastrointestinal system, stomach".

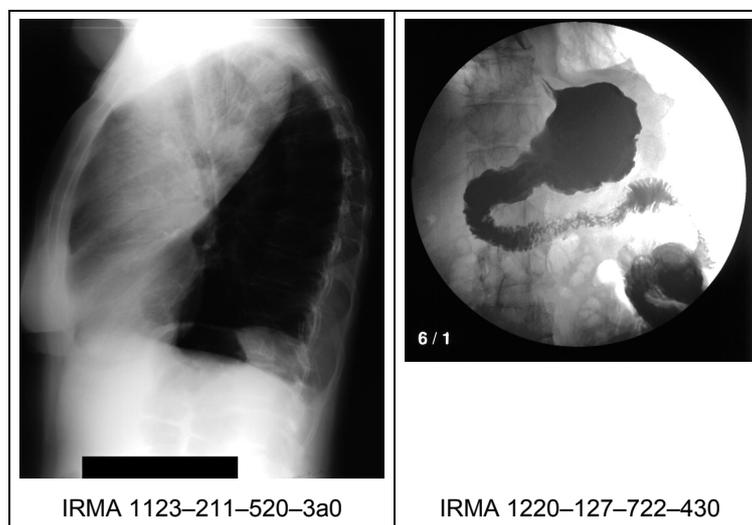


Figure 1: IRMA-coded chest and abdomen radiograph.

4. DISCUSSION

A basic requirement for coding medical images according to processing within a system for content-based retrieval is the mono-hierarchical structure of the code. Although several nomenclatures exist, these are neither causal, hierarchical, complete, nor unambiguous. For instance, valid instances for the DICOM tag "body part examined" are "skull", "cspine", "tspine", "lspine", "sspine", "coccyx", "chest", "clavicle", "breast", "abdomen", "pelvis", "hip", "shoulder", "elbow", "knee", "ankle", "hand", "foot", "extremity", "head", "heart", "neck", "arm", "jaw", and "special" [9]. Note the different grade of differentiation (e.g., "cspine", "tspine", "lspine", "sspine" vs. "skull"), the incompleteness (e.g., "arm" but not "leg"), and the ambiguities (e.g., "extremity" vs. "arm" or "hand").

The MeSH thesaurus is a poly-hierarchical structure where entities can be reached on different paths [10]. For instance, the IRMA T-code 1111 "dual energy digital plain x-ray" corresponds to the 2002 MeSH codes E01.370.350.700.700.700, E01.370.350.760.700, and E01.370.350.600.350.700.700 for "radiography, dual energy scanned projection". Furthermore, the MeSH thesaurus is not sufficiently detailed in all of the IRMA axis, especially for the T-axis.

Although it was demonstrated that SNOMED [11] is the most complete reference terminology in existence today for the clinical environment [12], its incompleteness with respect to technical usage for image retrieval reveals a major disadvantage of SNOMED when compared to the IRMA code. For instance, the SNOMED DICOM microglossary offers "breast" but not "mammary gland" [3].

In summary, the IRMA coding scheme is closest related to the JJ1017 code [3]. Likewise the JJ1017 approach, the IRMA code enables image classification with respect to technical, directional, anatomical, and biological criterions. In contrast to JJ1017, IRMA is more detailed, offers four instead of three separated axes for the four parameters described above, and is strictly mono-hierarchical in each axis. In addition, ambiguities of JJ1017 are avoided. For instance, JJ1017 offers "chest", "chest/abdomen", and "abdomen" on the first level of its "large region code" and hence, it is not suitable for content-based image retrieval in medical applications.

Based on its structure, the IRMA code can easily be extended (adding new characters to a certain code position) and refined. For instance, the IRMA B-code 411 "oral cavity" for the biological system imaged can be further specified if required for other usage than content-based image retrieval, e.g., 4110 "unspecified", 4111 "tongue" 4112 "floor of mouth", 4113 "hard palate", 4114 "soft palate", 4115 "cheek".

So far, the coding support was easy to use in about 6,000 single images, the loading time for the small images (about 200 pixels either direction) was short, the support of the javascripts in case of unknown combinations of the coding scheme was helpful. It turned out that rarely (less than 0.1 %) the regional code is too limited to describe the body parts depicted on a radiograph. This is especially true for long extremity overviews. The extremity codes allows only a very general or a highly specific localization of a combination of two nearby regions [8].

5. CONCLUSION

A mono-hierarchical multi-axial code scheme is presented that enables a unique classification of medical images. The entire code results in a character string of not more than 13 characters. The code can be easily extended by introducing characters in certain code positions, e.g., if new modalities are introduced. In contrast to other approaches, mixtures of one- and two-literal code positions are avoided which simplifies automatic code processing. Furthermore, the IRMA code steers clear of ambiguities resulting from overlapping code elements within the same level. Although this code was originally designed to be used in the IRMA project, other use is welcome.

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APPENDIX

A Technical code for imaging modality

Note that the non-radiological part of this code (4 “nuclear medicine”, 5 “optical imaging”, 6 “biophysical procedures”, 7 “others”, 8 “secondary digitization”) are not modeled completely.

0	unspecified
1	x-ray
10	unspecified
11	plain radiography
110	unspecified
111	digital
1110	unspecified
1111	overview image

1112	tomography
1113	high beam energy
1114	low beam energy
1115	far view projection
1116	1:1 projection
1117	dual energy
112	analog
1120	unspecified
1121	overview image
1122	tomography
1123	high beam energy
1124	low beam energy
1125	far view projection
1126	1:1 projection
113	x-ray stereometry
114	x-ray stereography

	115	tomosynthesis		2215	variable frequency
	116	xeroradiography		222	linear scan
12		fluoroscopy		2220	unspecified
	120	unspecified		2221	3.5 MHz
	121	digital		2222	5.0 MHz
	122	analog		2223	7.5 MHz
13		angiography		2224	10 MHz
	130	unspecified		2225	variable frequency
	131	digital	23		M-mode
	1310	unspecified		230	unspecified
	1311	subtraction (DSA)		231	3.5 MHz
	1312	rotation		232	5.0 MHz
		angiography		233	7.5 MHz
	1313	pathfinder technique		234	10 MHz
	132	analog	24		compound mode
	1320	unspecified		240	unspecified
	1321	photo subtraction		241	3.5 MHz
14		computed tomography (CT)		242	5.0 MHz
	140	unspecified		243	7.5 MHz
	141	conventional CT		244	10 MHz
	1410	unspecified		245	variable frequency
	1411	low dose	25		SieScape mode
	1412	high resolution		250	unspecified
	1413	bolus tracking		251	3.5 MHz
	142	quantitative CT		252	5.0 MHz
	1420	unspecified		253	7.5 MHz
	1421	dual energy		254	10 MHz
15		DEXA (quantitative radiography)		255	variable frequency
	150	unspecified	26		duplex mode
	151	digital		260	unspecified
	1510	unspecified		261	3.5 MHz
	1511	dual energy		262	5.0 MHz
16		radiotherapy		263	7.5 MHz
	160	unspecified		264	10 MHz
	161	digital		265	variable frequency
	162	analog	27		Doppler mode
2		sonography		270	unspecified
	20	unspecified		271	3.5 MHz
	21	A-mode		272	5.0 MHz
	210	unspecified		273	7.5 MHz
	221	3.5 MHz		274	10 MHz
	212	5.0 MHz		275	variable frequency
	213	7.5 MHz	28		3D imaging
	214	10 MHz		280	unspecified
	215	variable frequency		281	3.5 MHz
22		B-mode		282	5.0 MHz
	220	unspecified		283	7.5 MHz
	221	sector scan		284	10 MHz
	2210	unspecified		285	variable frequency
	2211	3.5 MHz	3		magnetic resonance measurements
	2212	5.0 MHz		30	unspecified
	2213	7.5 MHz		31	magnetic resonance imaging (MRI)
	2214	10 MHz		310	unspecified

311	T1-weighted		3142	body	
	3110	unspecified	3143	body array	
	3111	endo coil	3144	head coil	
	3112	body	3145	neck coil	
	3113	body array	3146	spine coil	
	3114	head coil	3147	loop coil	
	3115	neck coil	3148	shoulder coil	
	3116	spine coil	3149	knee coil	
	3117	loop coil	314a	hand / small FOV	
	3118	shoulder coil	314b	mamma coil	
	3119	knee coil	314c	flexible coil, large	
	311a	hand / small FOV	314d	flexible coil, small	
	311b	mamma coil	314e	endorectal coil	
	311c	flexible coil, large	314f	wrap around coil	
	311d	flexible coil, small	315	Cine-Lolo	
	311e	endorectal coil		3150	unspecified
	311f	wrap around coil		3151	endo coil
312	T2-weighted			3152	body
	3120	unspecified		3153	body array
	3121	endo coil		3154	head coil
	3122	body		3155	neck coil
	3123	body array		3156	spine coil
	3124	head coil		3157	loop coil
	3125	neck coil		3158	shoulder coil
	3126	spine coil		3159	knee coil
	3127	loop coil		315a	hand / small FOV
	3128	shoulder coil		315b	mamma coil
	3129	knee coil		315c	flexible coil, large
	312a	hand / small FOV		315d	flexible coil, small
	312b	mamma coil		315e	endorectal coil
	312c	flexible coil, large		315f	wrap around coil
	312d	flexible coil, small	316	inversion recovery	
	312e	endorectal coil		3160	unspecified
	312f	wrap around coil		3161	endo coil
313	proton-weighted			3162	body
	3130	unspecified		3163	body array
	3131	endo coil		3164	head coil
	3132	body		3165	neck coil
	3133	body array		3166	spine coil
	3134	head coil		3167	loop coil
	3135	neck coil		3168	shoulder coil
	3136	spine coil		3169	knee coil
	3137	loop coil		316a	hand / small FOV
	3138	shoulder coil		316b	mamma coil
	3139	knee coil		316c	flexible coil, large
	313a	hand / small FOV		316d	flexible coil, small
	313b	mamma coil		316e	endorectal coil
	313c	flexible coil, large		316f	wrap around coil
	313d	flexible coil, small	317	FLARE	
	313e	endorectal coil		3170	unspecified
	313f	wrap around coil		3171	endo coil
314	fat suppression			3172	body
	3140	unspecified		3173	body array
	3141	endo coil		3174	head coil

3175 neck coil
 3176 spine coil
 3177 loop coil
 3178 shoulder coil
 3179 knee coil
 317a hand / small FOV
 317b mamma coil
 317c flexible coil, large
 317d flexible coil, small
 317e endorectal coil
 317f wrap around coil
 318 3D-FFE high resolution
 3180 unspecified
 3181 endo coil
 3182 body
 3183 body array
 3184 head coil
 3185 neck coil
 3186 spine coil
 3187 loop coil
 3188 shoulder coil
 3189 knee coil
 318a hand / small FOV
 318b mamma coil
 318c flexible coil, large
 318d flexible coil, small
 318e endorectal coil
 318f wrap around coil
 32 spectroscopy
 4 nuclear medicine
 40 unspecified
 41 scintillation probe
 42 gamma camera
 43 single photon emission
 computed tomography (SPECT)
 44 positron emission tomography (PET)
 5 optical imaging
 50 unspecified
 51 endoscopy
 52 microscopy
 53 photography
 54 funduscopy
 55 laser surface scan
 56 thermography
 6 biophysical procedures
 60 unspecified
 61 electric
 62 magnetic
 63 probes
 7 others
 70 unspecified
 71 workstation
 72 hardcopy
 73 secondary capture

74 documentation
 740 unspecified
 741 value
 742 curve local
 743 curve temporal
 744 area complex (3D)
 745 picture
 746 local series
 747 temporal series
 748 complex series (4D)
 749 cine documentation
 74a fluoroscopy
 74b volume (data set)
 74c volume temporal (data set)
 8 secondary digitalization
 80 unspecified
 81 laser sampling
 82 LCD sampling
 83 video digitizing

B Directional code for imaging orientation

0 unspecified
 1 coronal
 10 unspecified
 11 posteroanterior (PA)
 110 unspecified
 111 inspiration
 112 expiration
 113 valsalva
 114 phonation
 115 upright
 116 sitting
 117 supine
 118 prone
 119 lateral decubitus
 11a flexion, left
 11b flexion, right
 11c swallow
 11d micturition
 11e bending
 12 anteroposterior (AP, coronal)
 120 unspecified
 121 inspiration
 122 expiration
 123 valsalva
 124 phonation
 125 upright
 126 sitting
 127 supine
 128 prone
 129 lateral decubitus
 12a flexion, left
 12b flexion, right
 12c swallow

	12d	micturition
	12e	bending
2	sagittal	
	20	unspecified
	21	lateral, right-left
	210	unspecified
	211	inspiration
	212	expiration
	213	Valsalva
	214	Hitzenberg maneuver
	215	upright
	216	supine
	217	prone
	218	inclination
	219	reclination
	21a	swallow
	21b	defaecation
	21c	micturition
	22	lateral, left-right
	220	unspecified
	221	inspiration
	222	expiration
	223	Valsalva
	224	Hitzenberg maneuver
	225	upright
	226	supine
	227	prone
	228	inclination
	229	reclination
	22a	swallow
	22b	defaecation
	22c	micturition
	23	mediolateral
	24	lateromedial
3	axial	
	30	unspecified
	31	craniocaudal
	32	caudocranial (transversal, axial)
4	other orientation	
	40	unspecified
	41	oblique
	42	occipitofrontal
	43	occipitomental
	44	bregmaticooccipital
	45	submentobregmatical
	46	submentobregmaticofrontal
	47	bregmaticooral
	48	bregmaticosubmental
	49	right anterior oblique (RAO)
	4a	left anterior oblique (LAO)
5	RSA / ap and lateral (simultaneously)	
C	Anatomical code for body region examined	
0	unspecified	

1	whole body
10	unspecified
11	torso
12	extremities
2	cranium
20	unspecified
21	facial cranium
210	unspecified
211	forehead
212	eye area
213	nose area
214	maxilla
215	mandible
216	temporo mandibular area
22	cranial base
220	unspecified
221	petrous bone
222	sella
23	neuro cranium
230	unspecified
231	frontal area
232	parietal area
233	occipital area
3	spine
30	unspecified
31	cervical spine
310	unspecified
311	dens
312	axis
313	upper cervical spine
314	lower cervical spine
32	thoracic spine
320	unspecified
321	cervico-thoracic conjunction
322	upper thoracic spine
323	middle thoracic spine
324	lower thoracic spine
33	lumbar spine
330	unspecified
331	thoraco-lumbar conjunction
332	upper lumbar spine
333	lower lumbar spine
34	sacral bone
340	unspecified
341	lumbo-sacral conjunction
35	coccygeal bone
4	upper extremity / arm
40	unspecified
41	hand
410	unspecified
411	finger
412	middle hand
413	carpal bones
42	radio carpal joint

43 forearm
 430 unspecified
 431 distal forearm
 432 proximal forearm
 44 elbow
 45 upper arm
 450 unspecified
 451 distal upper arm
 452 proximal upper arm
 46 shoulder
 460 unspecified
 461 scapula
 462 humero-scapular joint
 463 acromio-scapula joint

5 chest
 50 unspecified
 51 bones
 510 unspecified
 511 clavicle
 512 sternoclavicle region
 513 sternum
 514 upper ribs
 515 lower ribs
 52 lung
 520 unspecified
 521 upper lobe
 522 middle lobe
 523 lower lobe
 53 hilum
 54 mediastinum
 540 unspecified
 541 anterior mediastinum
 542 middle mediastinum
 543 posterior mediastinum
 55 heart
 56 diaphragm

6 breast (mammary)

7 abdomen
 70 unspecified
 71 upper abdomen
 710 unspecified
 711 upper right quadrant
 712 upper middle quadrant
 713 upper left quadrant
 72 middle abdomen
 720 unspecified
 721 middle right abdomen
 722 peri navel region
 723 middle left quadrant
 73 lower abdomen
 730 unspecified
 731 lower right quadrant
 732 lower middle quadrant
 733 lower left quadrant

8 pelvis
 80 unspecified
 81 sacral bone
 810 unspecified
 811 iliosacral-junction
 82 iliac bone
 83 pubic bone
 830 unspecified
 831 symphysis
 84 small pelvis
 840 unspecified
 841 sacral bone
 842 ischial bone

9 lower extremity / leg
 90 unspecified
 91 foot
 910 unspecified
 911 toe
 912 middle foot
 913 tarsal bones
 92 ankle joint
 93 lower leg
 930 unspecified
 931 distal lower leg
 932 proximal lower leg
 94 knee
 940 unspecified
 941 patella
 95 upper leg
 950 unspecified
 951 distal upper leg
 952 proximal upper leg
 96 hip

D Biological code for system examined

0 unspecified
 1 cerebrospinal system
 10 unspecified
 11 central nervous system
 110 unspecified
 111 metencephalon, cerebrum
 112 mesencephalon,
 diencephalon
 113 neurohypophysis,
 posterior pituitary gland
 114 cerebellum
 115 pons
 116 medulla oblongata
 117 spinal cord, cervical
 118 spinal cord, thoracic
 119 spinal cord, lumbar
 11a spinal cord, sacral
 (cauda equina)
 12 sense organs

	120	unspecified		34	mesopharynx
	121	vestibular sense		35	hypopharynx
	122	hearing sense		36	larynx
	123	gustatory sense		37	trachea
	124	tactile sense		38	main bronchus
	125	vision sense		39	bronchi
	126	olfactory sense		3a	lung
13		vegetative nervous system		3b	pleura
	130	unspecified		3c	ribs
	131	sympathic chain		3d	diaphragma
	132	glomus jugulare		3e	intercostal muscles
	133	glomus caroticum	4		gastrointestinal system
	134	ganglion stellatum		40	unspecified
	135	ganglion coeliacum		41	oropharynx
	136	organ of Zuckerkandl		410	unspecified
	137	adrenal medulla		411	oral cavity
2		cardiovascular system		412	epipharynx
	20	unspecified		413	mesopharynx
	21	heart		414	hypopharynx
	210	unspecified		42	esophagus
	211	pericardium		420	unspecified
	212	atrium		421	upper esophagus sphincter
	213	mitral valve		422	upper third
	214	tricuspidal valve		423	middle third
	215	ventricle		424	lower third
	216	aortic valve		425	lower esophagus sphincter
	217	pulmonary valve		43	stomach
22		arteries		430	unspecified
	220	unspecified		431	cardia
	221	ascending aorta		432	fundus
	222	aortic arche		433	corpus
	223	brachiocephalic trunk		434	antrum
	224	common carotic artery		435	pylorus
	225	botalli ligament & ductus arteriosus		44	small intestine
	226	descending aorta		440	unspecified
	227	bronchial trunk		441	duodenum
	228	abdominal aorta		442	jejunum
	229	celiac trunk		443	ileum
	22a	common iliac artery		444	terminal ileum
	22b	other arteries		445	ileocecal valve
23		veins		45	large intestine
	230	unspecified		450	unspecified
	231	anonymus vein		451	ascending colon
	232	brachiocephalic vein		452	transverse colon
	233	superior vena cava		453	descending colon
	234	inferior vena cava		454	sigmoid colon
	235	common iliac vein		455	rectum
	236	other veins		46	appendix
3		respiratory system		47	anus
	30	unspecified		48	liver
	31	nose		480	unspecified
	32	sinuses		481	parenchyma
	33	nasopharynx & epipharynx		482	bile ducts
				483	portal vein

484 arteries
 485 veins
 49 biliary system
 490 unspecified
 491 bile ducts
 492 gallbladder
 4a salivary glands
 4a0 unspecified
 4a1 parotic gland
 4a2 sublingual gland
 4a3 mandibular gland
 4a4 pancreas
 5 uropoietic system
 50 unspecified
 51 kidney
 510 unspecified
 511 parenchyma
 512 renal pelvis
 52 ureter
 53 urinary bladder
 54 urethra
 6 reproductive system
 60 unspecified
 61 male system
 610 unspecified
 611 testes
 612 deferent duct &
 seminal vesicle
 613 prostate gland
 614 penis
 (incl. corpus cavernosum)
 62 female system
 620 unspecified
 621 ovaries
 622 tuba uterina
 623 uterus
 624 vagina
 625 breast
 7 musculoskeletal system
 8 endocrinic system
 80 unspecified
 81 thyroid gland
 82 parathyroid gland
 83 adrenal gland
 84 pituitary gland
 85 hypothalamus
 86 ovaries
 87 testes
 88 pancreas
 9 immunic system
 90 unspecified
 91 tonsils
 92 cervial lymph node
 93 axillary lymph node

94 mediastinal lymph node
 95 thymus
 96 spleen
 97 retroperitoneal lymph node
 98 intraperitoneal lymph node
 980 unspecified
 981 mesenterial lymph node
 99 iliac lymph node
 9a inguinal lymph node
 9b bone marrow
 a dermal system